along the mainland from the Stikine River to Yakutat Bay. Admiralty, Douglas, Hecata, and Wrangell Islands were also infested. The most notable urban area outbreaks were in Juneau and Wrangell. A short period of zero temperature in March did not kill overwintering adults. The population began to build toward the end of April to the degree that winged adults were present in July. Trees with spruce aphids often had large conifer aphids. Tree mortality occurred in the Juneau area.

Figure 10. Spruce aphid feeding on a spruce needle.

Western Black-headed Budworm

Acleris gloverana Walsingham

The black-headed budworm occurs primarily in southeast Alaska and has been documented there since the early 1900s. Occasional, extensive outbreaks of this forest pest occur in other coastal areas of the State as well, including the Turnagain Arm of Cook Inlet, Prince William Sound, and southwestern Alaska. Though western hemlock is usually the primary host, western black-headed budworm also impact Sitka spruce, white spruce, and mountain hemlock. Historically, outbreaks of western black-headed budworm are highly cyclic, characterized by rapid increases in number followed, in 1–5 years, by equally rapid declines. Budworm populations appear to be highly susceptible to adverse weather conditions.

In southwestern Alaska, 2001 aerial surveys detected 30,000 acres of white spruce defoliation attributable to western black-headed budworm in the Wood River–Tikchik State Park, specifically from Nunavaugaluk Lake north to Lake Nerka. Within the State Park: Grant Lake reported 5,271 acres of light defoliation; Lake Nerka, 17,677 acres of light and medium defoliation; Lake Aleknagek had 2,486 acres of light defoliation and 3,703 acres of heavy defoliation; while Nunavaugaluk Lake reported 1,184 acres of light defoliation. The last time budworm defoliation was detected in this area was in 1979, when nearly 3,000 acres of white spruce defoliation were noted in the Lake Kulik–Grant Lake area. No further evidence of that outbreak was found the following year.

In Prince William Sound this year, nearly 21,000 acres of hemlock defoliation was noted from the Copper River Delta to Valdez Narrows. The breakdown is as follows: Valdez Arm, 4,769 acres; Bligh Island, 935 acres; Tatitlek, 515 acres; Boulder Bay, 299 acres; Landlocked Bay, 722 acres; Port Fidalgo, 1,186 acres; Port Gravina, 2,340 acres; Orca Bay, 138 acres; and Hawkins Island, 564 acres. East of Cordova, between Sheridan Glacier and the Copper River, 4,227 acres of defoliation were observed, while along the Martin River, 3,782 acres of defoliation were reported.

In southeast Alaska, a peak year for budworm defoliation occurred in 1993, totaling 258,000 acres. The last budworm outbreak of this magnitude occurred from the late 1940's to mid-1950. Black-headed budworm populations crashed in 1995. Since 1998 no budworm defoliation was reported in southeastern Alaska.

Hemlock Sawfly

Neodiprion tsugae Middleton

Hemlock sawfly, a common defoliator of western hemlock, is found throughout southeast Alaska. Historically, sawfly outbreaks in southeast Alaska have been larger and of longer duration in areas south of Frederick Sound. In 1999, sawfly defoliation was virtually nonexistent, this coming after a peak in 1997 when 2,500 acres were recorded.

In 2000, most of the 5,200 acres of activity occurred in "hot spot locations" in Kasaan Bay, Prince of Wales Island, Burroughs Bay north of Ketchikan, and Windham Bay east of Admiralty Island. In 2001, most of the 1,260 acres were infested south of Fredrick Sound.

Unlike the larvae of the black-headed budworm, hem-

lock sawfly larvae feed in groups, primarily on older hemlock foliage. These two defoliators, feeding in combination, have the potential to completely defoliate western hemlock. Heavy defoliation of hemlock by sawflies is known to cause reduced radial growth and top-kill. Hemlock sawflies may ultimately influence both stand composition and structure. The sawflies themselves are a food source for numerous birds, other insects, and small mammals.

Spruce Budworm and Coneworm

Choristoneura fumiferana (Clemens)
Choristoneura orae (Freeman)
Dioryctria reniculelloides Mutuura & Munroe
Zeiraphera spp.

During aerial surveys in 2000, nearly 41,000 acres of defoliated white spruce along the Christian River were mapped. No evidence of this outbreak was observed during 2001 surveys. Activity along the Tanana and Teklanika Rivers continues but the large Yukon River outbreak of several years ago appears to be over. Nearly 9,500 acres of light spruce budworm defoliation was mapped along the Teklanika River approximately 5 miles southwest of Nenana, while 16,000 acres of light to moderate defoliation was observed along the Tanana River extending from the mouth of the Kantishna River, northeast and along the Tanana River to Grassy Lake.

Larch Sawfly

Pristiphora erichsonii (Hartig)

In 2001, larch sawfly activity continued a decline that began in 1999 when sawfly populations impacted nearly 450,000 acres. This year, larch sawfly defoliation fell to 17,821 acres, down from the 64,859 acres reported in 2000 (minus 73 percent). The steady decline of this infestation is due to massive mortality incurred by native larch in interior Alaska. Throughout the course of this infestation, first observed during aerial surveys in the summer of 1993, over 200,000 acres of larch have been affected by substantial mortality. Eight years of increasingly heavy defoliation has taken its toll on these vast stands of larch. The most heavily impacted area is in the "Farewell Burn," between the Alaska Range and the Kuskokwim River south of McGrath where one can now fly for miles without seeing a live larch. With the exception of 445 acres of heavy defoliation approximately 10 miles northeast of McGrath along the Kuskokwim River, and 606 acres of light activity along the mid-portion of

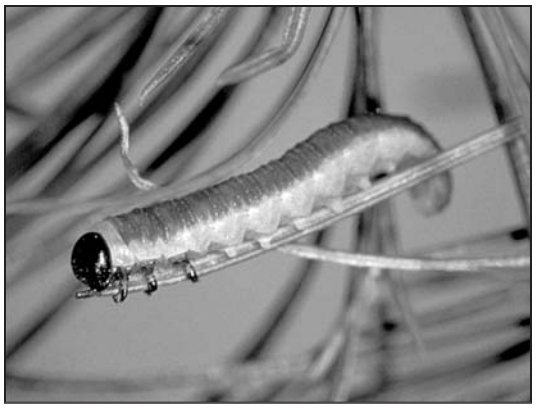


Figure 11. Larch sawfly larva.

the Kantishna River, the remaining 16,707 acres of larch defoliation is occurring on or just outside the Innoko National Wildlife Refuge. It is reasonable to assume that if active defoliation continues in this area, these stands too, will incur considerable mortality. A biological evaluation conducted in August 2000 within the Innoko National Wildlife Refuge by Forest Health Protection staff found that within the areas studied, 70 percent of the live larch were 70 percent plus defoliated, while 27 percent of the total component of larch had died. It was presumed that larch suffering repeated seasons of defoliation would be predisposed to attack by larch beetle, but apparently, this has not happened. The mortality incurred seems to be primarily attributable to larch sawfly defoliation.

In south-central Alaska, the larch sawfly has continued its advance southward affecting ornamental Siberian Larch plantings from Sterling to Homer on the Kenai Peninsula. In what appeared to be an accidental introduction, first noted in the MatSu Valley and within the Municipality of Anchorage (Anchorage Bowl, Eagle River) during 1999 surveys by Cooperative Extension technicians, this pest of native larch, in interior Alaska, has apparently established a solid foothold south of the Alaska Range into south-central Alaska's urban and community forest areas. While larch is not native to the Kenai Peninsula, it is a popular landscape tree. In several cases reported to Alaska Division of Forestry, private contractors initiated chemical controls. However, several other reports indicated that remedial and cultural measures such as water sprays, insecticidal soaps, and fertilizing and watering regimens were equally effective in urban situations. The ornamental (Siberian) larch plantings appear to be less susceptible to stress from repeated defoliation by the sawfly and are responding better to nonchemical control

measures. Expansion of the larch sawfly into the south-central Alaska urban areas has been swift and it appears that eradication is not feasible or practical. Additional tracking of this expansion will be continued to see if the introduction of biological controls (parasites, predators) might be warranted.

Aspen Leaf Miner

Phyllocnistis populiella (Chambers)

Widespread, intensive defoliation of aspen by the aspen leaf miner was noticeable, for the second consecutive year, throughout interior Alaska, especially from the Tanana Valley south to Eagle and east into the Yukon Territory, Canada.

Meandering larval mines are produced in the epidermal layers on the undersides of leaves. Such mining reduces the photosynthetic area of the affected leaves. Heavy repeated attacks reduce tree growth and may cause some top-kill.

Adult moths overwinter under bark scales of aspen. Adults emerge in early June and deposit eggs singly on the leaf edge then slightly fold the leaf to form a protective covering for the egg until larval emergence. The newly hatched larvae bore into and feed between epidermal leaf tissues. Pupation occurs within the larval leaf mines. Adult emergence occurs prior to or sometimes after the leaves drop in late August and September.

Birch Defoliation

Fenusa pusilla (Lepeletier)

For the fifth consecutive year, birch defoliation was very noticeable in the Anchorage Bowl from late July to August. Although these hardwoods have been defoliated for several consecutive years, as yet there doesn't appear to be any lasting damage.

The causal agent appears to be *Fenusa pusilla*, although this identification is tentative. It appears that this leaf miner is a recent introduction into the Anchorage Bowl: it was not observed before 1996 and is only concentrated in the Anchorage Bowl area. It has not been observed in forest settings. This birch leaf miner was first reported in eastern United States in 1923. Introduced from Europe, it has spread rapidly throughout the northern United States, Canada, and recently into Alaska. The adult sawfly is black, about 3 mm long, and similar in appearance to a common fly. Larvae overwinter in cocoons in the soil and adults appear in the spring when the first birch leaves

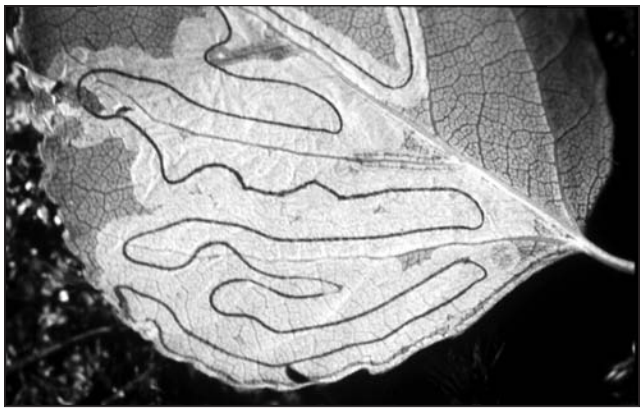


Figure 12. Larval galleries of the aspen leaf miner, *Phyllocnistis populiella*.

are half grown. The female sawfly deposits her eggs singly on newly developing leaves. At times, almost every leaf is mined by the developing larvae, giving it a brown color. When mature, the larva cuts a hole through the leaf and drops to the ground. There the larvae build a cell in which pupation takes place; 2–3 weeks are usually required for transformation into the adult stage. A reflushing of leaves may occur, and a second generation of egg-laying sawflies may develop. Two to four generations of this insect can develop in northeastern U.S.; the number of generations in Alaska is not known.

Large Aspen Tortrix

Choristoneura conflictana Wlkr.

Large aspen tortrix defoliated approximately 7,100 acres of aspen in south-central and interior Alaska during the summer of 2001. This figure is up moderately (plus 22 percent) from the 5,576 acres reported in 2000, but is consistent with the cyclic nature of populations of this insect. Five miles southwest of Willow, tortrix heavily defoliated 5,819 acres of aspen along the Susitna River. On the Yukon River, several miles upriver from the village of Rampart, tortrix lightly defoliated nearly 1,000 acres of aspen in two discreet areas: 344 acres located 5 miles northwest of Rampart, and 652 acres at Chicago Lakes, 10 miles north of Rampart. The only other area of tortrix activity found during aerial surveys in 2001 was just off the Chitina River approximately 12 miles south of McCarthy where nearly 300 acres of aspen were lightly defoliated.

Cottonwood Defoliation

Chrysomela spp.
Epinotia solandriana L.

Cottonwood defoliation by the cottonwood leaf beetle (*Chrysomela*) was very heavy throughout south-central and interior Alaska. The black-colored leaf beetle larvae skeletonize the leaves of black cottonwood or poplar giving the trees a brown appearance. Over 9,000 acres were noted during the 2001 survey. The Anchorage Bowl and Seward area were most notable at nearly 5,000 acres but defoliation also occurred in the Coleen and Black River drainages.

In southeast Alaska, the majority of cottonwood defoliation on the west side of Russell Fiord near Yakutat was attributed to a leaf roller (*Epinotia solandriana*).

Willow Leaf Blotch Miner

Micrurapteryx salicifolliela (Chambers)

The outbreak of the willow leaf blotch miner continued in 2001 for the tenth consecutive year. This year, acres of defoliated willow have decreased considerably relative to last years figure of 36,000 acres. Only 10,864 acres of willow defoliation were mapped in 2001, representing a 60 percent decline over 2000 levels. The majority of the defoliated acreage this year (8,739 acres) was confined to the Yukon Flats Wildlife Refuge. Smaller active areas were located approximately 25 miles south of McCarthy along the Tana River (1500 acres) and along the Kantishna River (400 acres). The actual number of impacted acres is probably, much higher. In the past, this insect has been observed in many areas over the range of willow, particularly throughout the Yukon Flats National Wildlife Refuge. Time and monetary constraints do not allow full aerial survey coverage of this vast area, thus, large areas of willow away from the major river drainages are often overlooked. Though past mortality is not mapped on these aerial surveys, it should be noted that a considerable amount of willow mortality has been observed throughout the Yukon Flats National Wildlife Refuge. This mortality is assumed to be a result of repeated years of heavy defoliation by the willow leaf blotch miner.

Ten species of willow have been observed infested, the severity of which differed somewhat between localities and species. Feltleaf willow, *Salix alaxensis*, is not infested due to the under leaf surface being covered by a protective felt-like mat of hairs that prevents attachment of blotch miner eggs.

Alder Woolly Sawfly

Eriocampa ovata (L.)

Moderate defoliation of Sitka and thin-leaf alder was observed for the fifth consecutive year in many parts of the Anchorage Bowl. Similar to the birch leaf miner, the alder woolly sawfly appears to be a recent (less than six years) introduction into the state. This sawfly is a European species now established throughout the northern U.S., Canada, and recently into Alaska. The larvae are covered with a distinctive shiny, woolly secretion. They skeletonize the lower leaves on young alders; the upper crown is usually not fed upon. Populations are expected to decline next year as a result of this summer's cool and wet conditions.

Figure 13. Woolly alder sawfly larva.

Invasive Pests

Those who follow the national media are already familiar with a few key invasive pests, primarily insects, which have been introduced into the western U.S. over the last two decades. Invasive pests (introduced nonindigenous plants, animals, insects, and microbes) are among the most serious threats to biological diversity in Alaska; although, to date, few invasive pests have been introduced and established in Alaska. Of concern is the movement of organisms from the continental U.S. into Alaska in light of climate change and increased commerce. Likewise, the movement of native insects and pathogens from one area to another, apparently geographically isolated, is also problematic. A warming trend may increase the probability that organisms accidentally introduced into Alaska will become established. Once established, invasive pest populations can become difficult to control and manage since the complement of parasites and predators that normally control their numbers are at low levels, or absent.

It is inevitable that we are going to see more and more introduced pests "invading" both rural and urban forest areas of Alaska. If pest introductions are left to "run their course" or if we are not prepared to expend the efforts to safeguard our ecosystems, Alaska will be poorer in terms of resources and biological diversity. For example, without eradication efforts, many invasive insects could inadvertently become a dominant influence affecting native species of both pest and nonpest insect populations. The ability of many introduced pests to out-compete or displace the native species will complicate Integrated Pest Management (IPM) efforts already in place. USDA Animal & Plant Health Inspection Service (APHIS), the State of Alaska divisions of Agriculture and Forestry (AKDOF), University of Alaska Cooperative Extension Service (CES), and the USDA Forest Service, Forest Health Protection already have small programs in place to monitor and detect potential insect or plant introductions. Alaska residents, resource professionals, and land managers need to "keep a sharp eye" out for potential introduced pests and contact CES, APHIS, or AKDOF. If introduced pests are positively and quickly identified, the probability of successful eradication or IPM control efforts are increased.

While insect invasive pests are very obvious and direct in their effects on the habitat (and humans), most of the plant and disease invasives are initially less obvious or pervasive in their expansion into new habitats. Presently, most of the invasive plants are found in disturbed areas, primarily in the developed urban parks and on agricultural lands. Left unchecked, these invaders may overrun other disturbed areas, including forest harvest areas, field tree nurseries, etc., displacing native ground plant cover. Based on the CES reports, a number of weedy (plant) exotics are spreading through the urban forest and agricultural areas of Alaska at rates that are surprising, if not alarming, to many of the forest and agricultural pest and land management specialists working in Alaska. Many of these species have been introduced by accident into ecosystems where they thrive at the expense of native plant species by competing vigorously to displace the native species. Invasion is first over small areas, then over large areas as they dominate the local flora for available habitat. Most control problems are in areas with heavy human traffic such as along forest trails, ballparks, and other public areas. A major challenge is that seed can very efficiently be transported on shoes or clothing to other areas complicating control and eradication efforts.

To date, the initial work has been to establish a network for information flow on these often-unwelcome plant invaders. IPM specialists with CES have reported a number of plant exotics over the past several years that should help focus continued efforts. The first formal gathering of invasive and exotic plant researchers and specialists was held in Fairbanks in early 2001 to begin to address coordination of monitoring, control, and funding efforts for Alaska.

Based on records compiled over the last 2–3 years by Cooperative Extension Service (CES) Integrated Pest Management (IPM) specialists, introductions of invasive non-native plants to areas in and near Alaska's forests should be monitored. The distinction of "noxious" plants can be made for several of these species in that they have been shown to interfere with management objectives for a given area of land over a given period of time. The CES specialists in Anchorage, Delta Junction, Fairbanks, Juneau, and the Kenai Peninsula identified the following species (see below) as various forms of "biological pollution" to our urban environment during the past few years. These noxious plants and disease pests are becoming more noticeable and controls are being requested as people recognize that an introduced plant species can easily take over a planting. This is not an all-encompassing list of invasive "noninsect" species. With the exception of just a few species, the list does not have any regu-

latory implication. It is hoped that this list will serve to begin to track and provide additional information about invasive plants and diseases in future forest conditions reports, should they become of concern:

As reported by the Cooperative Extension Service during 1999-2001, the following species are currently on the State of Alaska Division of Agriculture's regulatory list; some are prohibited * or restricted ** noxious weeds. The State of Alaska's web site for the National Biological Information Infrastructure can be found at: http://www.invasivespecies.gov/geog/ state/ak.shtml

Canada thistle, *Cirsium arvense* * (a large patch was located in a Municipality of Anchorage park area as well as several other locations around Anchorage during the 2001 field season)

Bishop's weed, *Ptilimnium capillaceum*

Black knot, *Apiosporina morbosum*, on *Prunus* spp. (common on planting stock that has been outplanted for several years in Anchorage)

Butter-and-eggs, *Linnaria vulgaris*

Buttercup, *Ranunculas* spp.

Corn spurry, *Spergula arvensis*

Fire blight, *Erwinia amylovora* (seen on apple in 2000; potential for affecting other plants in the family Rosaceae, e.g., native mountain ash)

Horsetail, *Equisetum* spp.

Hawksbeard, *Crepis setosa*

Hempnettle, *Galeopsis tetrahit* *

Horsenettle, *Solanum carolinense* *

Japanese knotweed, *Polygonum cuspidatum*

Orange hawkweed, *Hieracium aurantiacum*

Perennial sowthistle, *Sonchus arvensus* *

Tufted Vetch, *Vicia cracca* **

Gypsy Moth

Lymantria dispar (L.)

The European gypsy moth was accidentally introduced into the eastern U.S. in the late 1800s and has been responsible for considerable damage to the hardwood forests of the east. The gypsy moth has also been introduced to the western U.S. where millions of dollars have been spent on its eradication.

Since 1986, Forest Health Protection, in conjunction with Alaska Cooperative Extension and USDA APHIS, has placed gypsy moth pheromone monitoring traps throughout Alaska. To date, only two European gypsy moths have been trapped in Alaska. As far as we know, populations of the gypsy moth have not been established in Alaska.

Due to the detection of the Asian gypsy moth (a more damaging race of the European gypsy moth) in the Pacific Northwest, more than 200 detection traps were placed throughout Alaska in 2001. No Asian or European gypsy moths were collected. If the Asian gypsy moth becomes established in the western U.S., including Alaska, the potential impacts to forest and riparian areas could be tremendous. The trapping program will be continued next year.

Figure 14. European gypsy moth larva.

Uglynest Caterpillar: Tortricidae

Archips cerasivorana (Fitch)

Cooperative Extension Service and Alaska Division of Forestry entomologists found the Uglynest caterpillar on Cotoneaster hedge plantings in west Anchorage, downtown and in south Anchorage. Adjacent mountain ash plantings at one location also sustained heavy branch dieback, apparently from initial caterpillar feeding. The insect has one generation per year, overwintering in the egg stage. The adult moths are active from June through August; the front wing is crossed with reddish brown striations and has an iridescent sheen; hind wings are bright orange. Larvae are yellowish to yellowish-green as they reach maturity with dark brown or black heads. All larval stages are gregarious and live in silk-covered tents or nests that become filled with frass as the larvae grow. This insect can be a problem in nurseries or ornamental plantings because of the unsightly appearance of the larval nests. The nests may also cause some branch deformity in subsequent years of heavy defoliation but little other permanent damage.

European Black Slug: Limacidae

Arion ater

The European black slug, an invertebrate, was detected twice in a local Anchorage garden in 2000, and again in 2001, and was likely imported on flats of bedding plants that originated from Washington State. Additional sightings were noted in Cordova this summer. A distinctive feature of this slug is the many grooves and ridges along the back. This reddish-brown slug has a distinctive striped red-orange skirt. When fully extended, this slug measures almost 6 inches in length. The European black slug is established in the northwest U.S. and is a serious pest of crops including corn, wheat, potatoes, beans and strawberries.

Figure 15. Uglynest caterpillar larvae.

Leopard Slug: Limacidae

Limax maximus

A slug (about 5 inches long and one-half inch diameter, tan–beige colored and with elongated black splotches all over its back except its mantle) was tentatively identified as a leopard slug last year. Local gardeners indicate that these slugs have been found about 15 miles north of Juneau for several years now. Populations were also observed in Cordova this summer.

Tufted Vetch

Vicca cracca L.

Do not be deceived by the pretty bluish-purple flowers. This climbing legume has been spotted growing aggressively around south Anchorage for the past several seasons, most notably along the Seward Highway. It is weak-stemmed with compound leaves and has a climbing habit that allows it to grow on and over other plants. It has been observed invading yards, other roadside locations, and along the Turnagain Arm trail in Chugach State Park and along the Glen Highway to Palmer. *Vicca cracca* is recognized as a restricted noxious weed by the State of Alaska. The easiest method to control this plant is by pulling it wherever encountered and bagging it up for disposal to ensure seeds are not left on site.

Figure 16. 2001 aerial surveys detected 30,000 acres of white spruce defoliation attributable to western black-headed budworm.

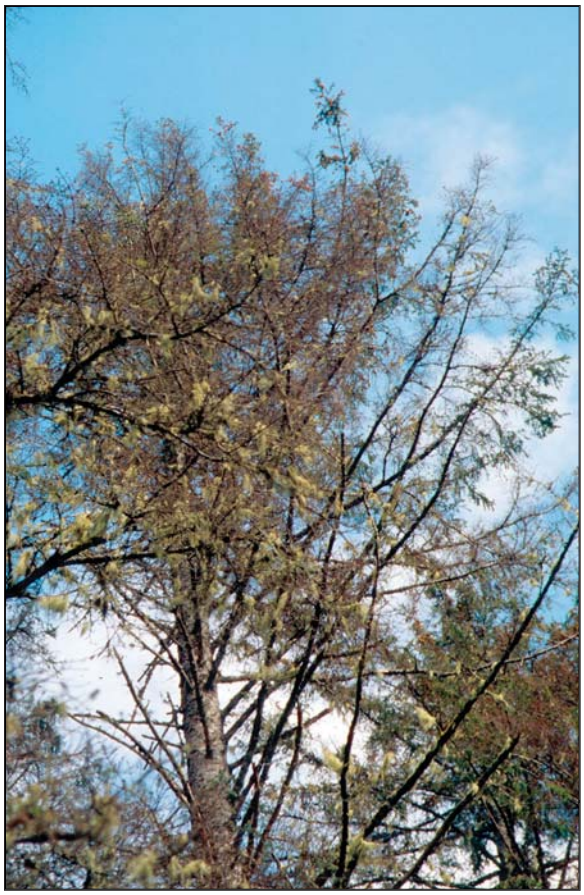
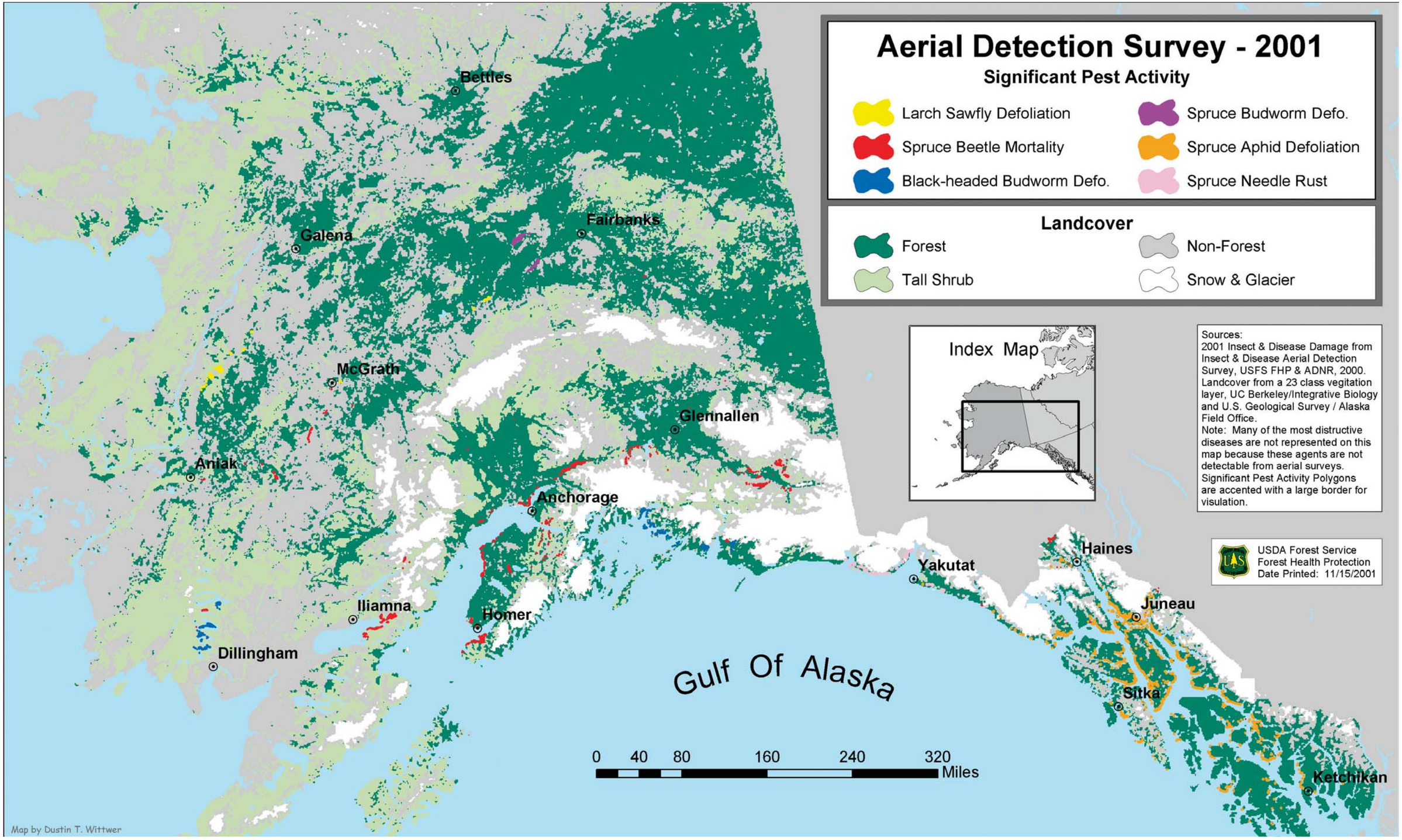


Figure 17. Areas of southeast Alaska experienced its fourth year of spruce aphid defoliation.

Figure 18. Uglynest caterpillar on Cotoneaster hedge plantings in Anchorage. All larval stages are gregarious and live in silk-covered tents.

Figure 19. A small bark beetle outbreak on subalpine fir was noted north of Skagway.

Map 5. General Forest Pest Activity in 2001.



Map 6. 2001 Survey Flight Paths Showing Ownership.

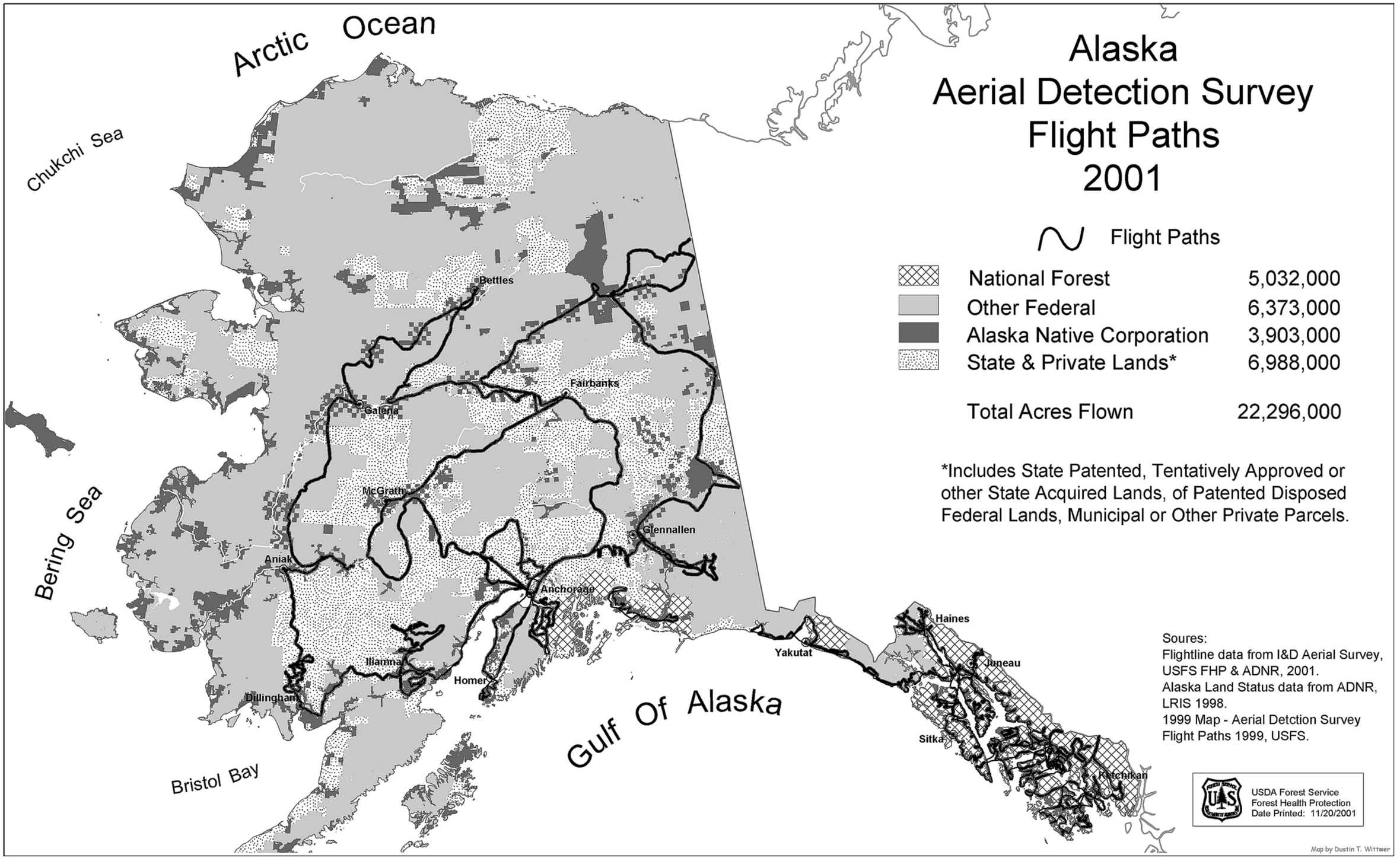


Figure 20. Chicken of the woods fruited prolifically this fall in the old-growth forests near Seldovia and throughout southeast Alaska. This fungus causes a brown rot in the lower stem of infected trees.

Figure 21. Hemlock canker was evident along several shoreline and roadside locations in 2001.

Figure 22. Fruiting bodies of the velvet top fungus, *Phaeolus schweinitzii*, indicate substantial wood decay in the lower stem and a high potential for bole breakage.

Figure 23. Yellow-cedar decline is distributed across a spectrum of stand types including this "scrubby" condition.